AD-A105 350 ANDERSON ENGINEERING INC SPRINGFIELD MO F/G 13/13
NATIONAL DAM SAFETY PROGRAM. HERMIT HOLLOW LAKE DAM (MO 31054),--ETC(U)
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LEVEL II

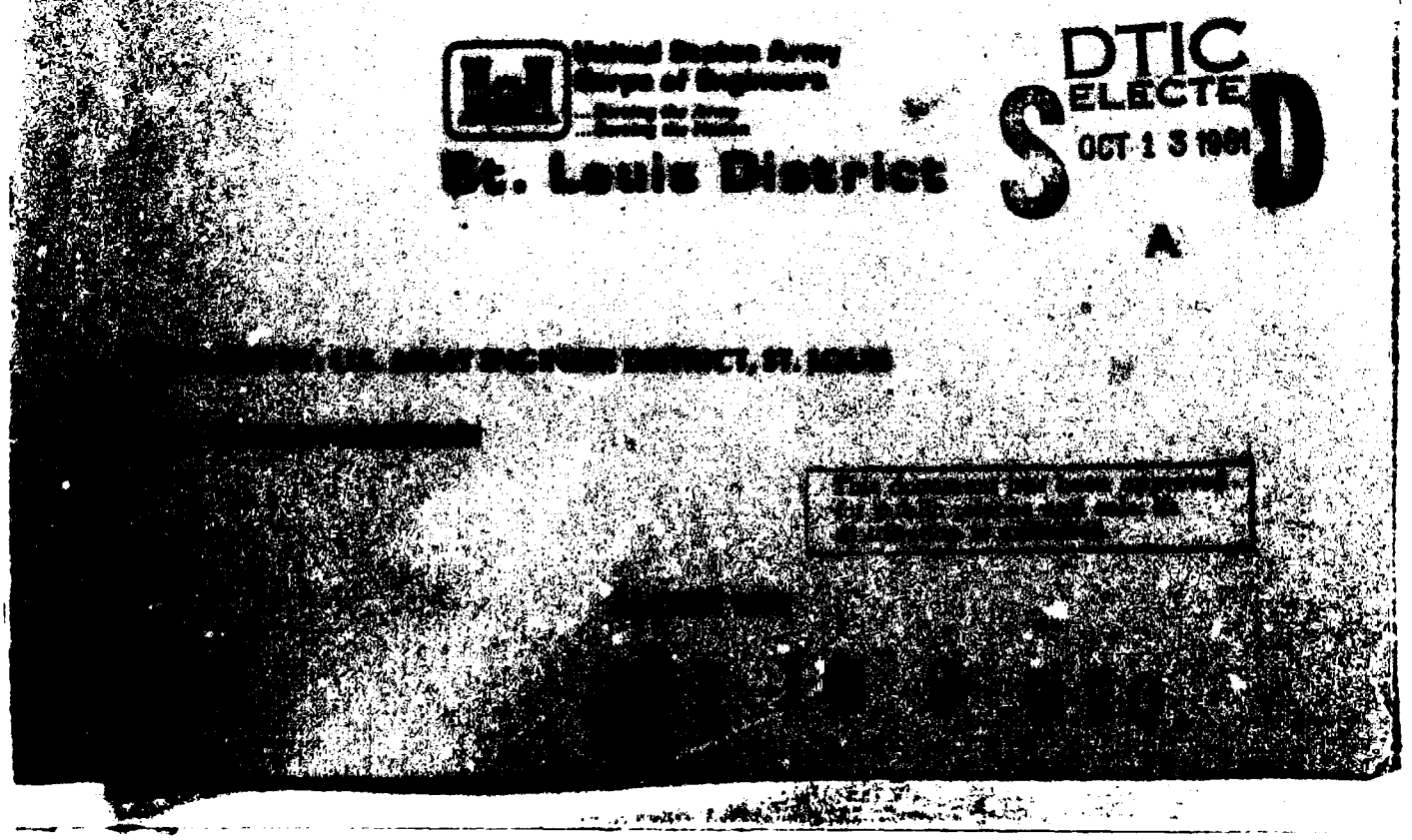
MISSISSIPPI - KASKASKIA - ST. LOUIS BASIN

HERMIT HOLLOW LAKE

FRANKLIN COUNTY, MISSOURI

MO 21054

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY INSPECTION



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REPORT DOCUMENTATION PAGE	READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO. AD-A105 350 / 3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Phase I Dam Inspection Report National Dam Safety Program Hermit Hollow Lake Dam (MO 31054) Franklin County, Missouri	5. TYPE OF REPORT & PERIOD COVERED Final Report 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Anderson Engineering, Inc.	8. CONTRACT OR GRANT NUMBER(s) DACW43-79-C-0070 ✓
9. PERFORMING ORGANIZATION NAME AND ADDRESS U.S. Army Engineer District, St. Louis Dam Inventory and Inspection Section, LMSED-PD 210 Tucker Blvd., North, St. Louis, Mo. 63101	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS U.S. Army Engineer District, St. Louis Dam Inventory and Inspection Section, LMSED-PD 210 Tucker Blvd., North, St. Louis, Mo. 63101	12. REPORT DATE August 1979 13. NUMBER OF PAGES Approximately 40
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)	15. SECURITY CLASS. (of this report) UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

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18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Dam Safety, Lake, Dam Inspection, Private Dams

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report was prepared under the National Program of Inspection of Non-Federal Dams. This report assesses the general condition of the dam with respect to safety, based on available data and on visual inspection, to determine if the dam poses hazards to human life or property.

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DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
210 NORTH 12TH STREET
ST. LOUIS, MISSOURI 63101

IN REPLY REFER TO

SUBJECT: Hermit Hollow Dam Phase I Inspection Report

This report presents the results of field inspection and evaluation of the Hermit Hollow Dam:

It was prepared under the National Program of Inspection of Non-Federal Dams

This dam has been classified as unsafe, non-emergency by the St. Louis District as a result of the application of the following criteria:

1) Spillway will not pass 50 percent of the Probable Maximum Flood
2) Overtopping could result in dam failure
3) Dam failure significantly increases the hazard to loss of life downstream

SUBMITTED BY: SIGNED
Chief, Engineering Division
22 AUG 1979
Date

APPROVED BY: SIGNED
Colonel, CE, District Engineer
22 AUG 1979
Date

HERMIT HOLLOW DAM

FRANKLIN COUNTY, MISSOURI

MISSOURI INVENTORY NO. 31054

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Hermit Hollow Lake Dam (MO31054),
Mississippi - Kaskaskia - St. Louis Basin,
Franklin County, Missouri. Phase I Inspection
Report.

Prepared By

Anderson Engineering, Inc., Springfield, Missouri
Hanson Engineers, Inc., Springfield, Illinois

(15) DACW43-79-C-0070

(9) Final rept.,

(10) Steve /Brady Gene /Wertephy
Tom /Beckley Dave /Daniels

Under Direction Of

St. Louis District, Corps of Engineers

For

Governor of Missouri

(11) Aug[redacted]79

(12) 57

PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam:	Hermit Hollow Dam
State Located:	Missouri
County Located:	Franklin
Stream:	Lartto Creek
Date of Inspection:	May 7, 1979

Hermit Hollow Dam was inspected by an interdisciplinary team of engineers from Anderson Engineering, Inc. of Springfield, Missouri and Hanson Engineers, Inc. of Springfield, Illinois. The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.

The guidelines used in the assessment were furnished by the Department of the Army, Office of the Chief of Engineers, and they have been developed with the help of several Federal and State agencies, professional engineering organizations, and private engineers. Based on these guidelines, the St. Louis District, Corps of Engineers has determined that this dam is in the high hazard potential classification, which means that loss of life and appreciable property loss could occur if the dam fails. The estimated damage zone extends approximately one mile downstream of the dam. Located within this zone are a factory, a dwelling and 5 buildings. The dam is in the small size classification, since it is greater than 25 ft high but less than 40 ft high, and the maximum storage capacity is greater than 50 ac-ft but less than 1000 ac-ft.

Our inspection and evaluation indicates that the spillway does not meet the criteria set forth in the guidelines for a dam having the above size and hazard potential. The spillway will pass 33 percent of the Probable Maximum Flood without overtopping. The Probable Maximum Flood is defined as the flood discharge that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region. The guidelines require that a dam of small size with a high downstream hazard potential pass 50 to 100 percent of the PMF. Considering this dam's small size and low storage capacity, 50 percent of the PMF has been determined to be the appropriate spillway design flood. The 100-year frequency flood will not overtop the dam. The 100-year flood is one that has a 1 percent chance of being exceeded in any given year.

Deficiencies visually observed by the inspection team were: (1) sloughing of upstream slope at and above the normal pool level all along the dam; (2) animal burrows on both faces of the dam; (3) light brush on the upstream face and several isolated areas of heavy brush on the downstream face; (4) two damp, mossy areas on the downstream face which could indicate some seepage; (5) one area on the downstream face which appears to be a small slough but was not active at the time of the inspection; and (6) debris and erosion in the spillway channel. Another deficiency was the lack of seepage and stability analysis records.

It is recommended that the owners take the necessary action in the near future to correct the deficiencies reported herein. A detailed discussion of these deficiencies is included in the following report.

Steve Brady, P.E. (AEI)

Gene Wertepny, P.E. (HEI)

Tom Beckley, P.E. (AEI)

Dave Daniels, P.E. (HEI)

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
HERMIT HOLLOW DAM - ID No. 31054

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APPENDICES

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL:

A. Authority:

The National Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of safety inspection of dams throughout the United States. Pursuant to the above, the St. Louis District, Corps of Engineers, District Engineer directed that a safety inspection be made of Hermit Hollow Dam in Franklin County, Missouri.

B. Purpose of Inspection:

The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and a visual inspection in order to determine if the dam poses hazards to human life or property.

C. Evaluation Criteria:

Criteria used to evaluate the dam were furnished by the Department of the Army, Office of the Chief of Engineers, "Recommended Guidelines for Safety Inspection of Dams, Appendix D." These guidelines were developed with the help of several federal agencies and many state agencies, professional engineering organizations, and private engineers.

1.2 DESCRIPTION OF PROJECT:

A. Description of Dam and Appurtenances:

Hermit Hollow Dam is an earth fill structure approximately 33 ft high and 365 ft long at the crest. The appurtenant works consist of a rock cut spillway in the south abutment. There are no other appurtenant structures. Sheet 3 of Appendix A shows a plan profile and typical section of the embankment.

B. Location:

The dam is located in the northeast part of Franklin County, Missouri on Lartto Creek. The dam and lake are within the Labadie, Missouri 7.5 minute quadrangle sheet

(Section 29, T44N, R2E - latitude 38° 31.5'; longitude 90° 48.8'). Sheet 2 of Appendix A shows the general vicinity.

C. Size Classification:

With an embankment height of 33 ft and a maximum storage capacity of approximately 139 acre-ft, the dam is in the small size category. A small size dam, as classified by the guidelines, is one with a height between 25 ft and 40 ft and/or a maximum storage capacity between 50 acre-ft and 1000 acre-ft.

D. Hazard Classification:

The St. Louis District, Corps of Engineers has classified this dam as a high hazard dam, which means that loss of life and appreciable property loss could occur if the dam fails. The estimated damage zone extends approximately 1 mile downstream of the dam. Located within this zone are a factory, a dwelling and 5 buildings.

E. Ownership:

The dam is owned by the trustees of the Hermit Hollow subdivision, in care of the president of the trustees, Mr. David Durrouch. The owner's address is Hermit Hollow, Route 1, Box 77 CII, Labadie, Missouri 63055.

F. Purpose of Dam:

The dam was constructed primarily for recreational purposes.

G. Design and Construction History:

The dam was constructed in 1962 by Mr. William Cassilly of Glendale, Missouri. The material for the dam was a clayey soil taken from the basin area and slopes upstream of the dam. Mr. Cassilly indicated that the dam is approximately 200 ft wide at the base and 15 ft wide at the top. Extrapolation of our survey data would indicate a maximum width of approximately 150 ft to 175 ft at the base. No plans or design information are available.

H. Normal Operating Procedures:

All flows are passed by a rock cut spillway in the south abutment. The builder of the dam indicated the highest water ever experienced was approximately 4 ft above normal pool (approximate elevation 101.8). According to the builder and present owners, the dam has never been overtopped.

1.3 PERTINENT DATA:

Pertinent data about the dam, appurtenant works and reservoir are presented in the following paragraphs. Sheet 3 of Appendix A presents a plan, profile and typical section of the embankment.

A. Drainage Area:

The drainage area for this dam, as obtained from the U.S.G.S. quad sheet, is approximately 249 acres.

B. Discharge at Dam Site:

(1) All discharge at the dam site is through an uncontrolled spillway.

(2) Estimated Total Spillway Capacity at Maximum Pool (Top of Dam - Avg. El. 103.3): 786 cfs

(3) Estimated Experienced Maximum Flood at Dam Site: 403 cfs (El. 101.8)

(4) Diversion Tunnel Low Pool Outlet at Pool Elevation: Not Applicable

(5) Diversion Tunnel Outlet at Pool Elevation: Not Applicable

(6) Gated Spillway Capacity at Pool Elevation: Not Applicable

(7) Gated Spillway Capacity at Maximum Pool Elevation: Not Applicable

C. Elevations:

(1) Top of Dam: 102.7 (low point); 103.7 (high point); 103.3 (average)

(2) Spillway Crest: 97.8

(3) Streambed at Centerline of Dam: 70.7 (Estimated)

(4) Pool on Date of Inspection: 97.7

(5) Apparent High Water Mark: 100 (on day of inspection); 101.8 (highest in history of dam)

(6) Maximum Tailwater: Unknown

(7) Upstream Portal Invert Diversion Tunnel: Not Applicablecable

(8) Downstream Portal Invert Diversion Tunnel: Not Applicable

D. Reservoir Lengths:

(1) At Top of Dam: 1550 ft

(2) At Spillway Crest: 1500 ft

E. Storage Capacities:

(1) At Spillway Crest: 82 Ac-ft

(2) At Top of Dam: 139 Ac-ft

F. Reservoir Surface Areas:

(1) At Spillway Crest: 9 Ac.

(2) At Top of Dam: 12 Ac.

G. Dam:

(1) Type: Earth Fill

(2) Length at Crest: 365 ft

(3) Height: 33 ft (maximum)

(4) Top Width: 10 ft

(5) Side Slopes: Upstream 1.3H:1V; Downstream 2.3H:1V (Avg.)

(6) Zoning: None (Homogeneous)

(7) Impervious Core: None

(8) Cutoff: 10 ft Deep by 6 ft Wide (from William Cassilly)

(9) Grout Curtain: None

H. Diversion and Regulating Tunnel:

(1) Type: None

(2) Length: N.A.

(3) Closure: N.A.

(4) Access: N.A.

(5) Regulating Facilities: N.A.

I. Spillway:

I.1 Principal Spillway:

(1) Location: South Abutment

(2) Type: Rock Cut

I.2 Emergency Spillway:

(1) Location: None

(2) Type: N.A.

J. Regulating Outlets:

There are no regulating outlets or draindown facilities for this dam.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN:

No engineering data exist for this dam. To our knowledge no construction inspection records or documented maintenance and operation data exist.

A. Surveys:

To our knowledge, no detailed surveys have been made of the dam. A manhole cover on the north abutment on the upstream side of the dam was used as datum for our site survey (assumed elevation = 100--see Sheet 3 of Appendix A). The manhole is associated with an apparent sewer system from the residences on the north side of the lake. The elevation of normal pool is estimated from the U.S.G.S. quad sheet as being 650 ft above mean sea level. Thus, 552 ft can be added to all elevations in this report to obtain approximate mean sea level elevations.

B. Geology and Subsurface Materials:

The site is located at the northeastern edge of the Ozarks. The Ozarks are characterized topographically by hills, plateaus and deep valleys. The most common rock types are dolomite, sandstone and chert. Information from the Missouri Geological Survey indicates a soil cover on the uplands and more gentle slopes of 15 ft over Joachim dolomite. The Joachim is evenly bedded with a relatively smooth weathered surface, and its fracture permeability is low. The "Geologic Map of Missouri" indicates that the nearest known faults are approximately 10 miles southwest of the site. The Missouri Geological Survey has indicated that the faults in the area are generally considered to be inactive and have been for several hundred million years. The publication "Caves of Missouri" indicates that most of the known caves in Franklin County are in the south-central portion (20 to 25 miles from the site).

Soils in the area of the dam are of the Menfro-Winfield-Weldon association and are low plasticity silty clays and clayey silts developed from 10 ft to 20 ft of loessial deposits (modified loess). The Missouri Geological Survey has indicated that residual soils are thin to absent in the area of this site.

C. Foundation and Embankment Design:

No design computations are available. Information from Mr. William Cassilly indicates that the dam is composed of materials taken from the basin area and slopes upstream of the dam. Our site inspection indicates that these materials are primarily low plasticity silty clays and clayey silts. Mr. Cassilly indicated that a 10 ft deep core trench was incorporated under the dam. No internal drainage features were used, nor is there any particular zoning of the embankment. No construction inspection records are available.

D. Hydrology and Hydraulics:

No hydrologic or hydraulic design data were obtained. Our analyses of the PMF are presented in Appendix C. These analyses were based on our field survey and observations, and estimates of areas and volumes from the U.S.G.S. quad sheet. It was concluded that the structure will pass 33 percent of the Probable Maximum Flood without overtopping. The 100-year frequency flood will not overtop the dam.

E. Structure:

There are no appurtenant structures associated with this dam.

2.2 CONSTRUCTION:

No construction and inspection data have been obtained.

2.3 OPERATION AND MAINTENANCE:

To our knowledge, there are no operating records. The owner, Mr. David Durrouch, indicated that trees and brush on the dam are cut every year. The builder indicated that the lake was lowered 8 ft last year with a 4 in. siphon over a period of two months. Silt in the upper end of the lake (beach and island area - see Photo no. 1) was excavated. The builder of the dam (Mr. Cassilly) indicated that the upstream face below the water level was viewed at that time and that no slides or sloughs below the normal pool level were observed.

2.4 EVALUATION:

A. Availability:

No engineering data, seepage or stability analyses, or construction test data were available.

B. Adequacy:

The engineering data available were inadequate to make a detailed assessment of the design, construction and operation of this structure. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record.

C. Validity:

To our knowledge, no valid engineering data on the design or construction of the embankment are available.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS:

A. General:

The field inspection was made on May 7, 1979. The inspection team consisted of personnel from Anderson Engineering, Inc. of Springfield, Missouri and Hanson Engineers, Inc. of Springfield, Illinois. The team members were:

Steve Brady - Anderson Engineering, Inc. (Civil Engineer)
Tom Beckley - Anderson Engineering, Inc. (Civil Engineer)
Gene Wertepny - Hanson Engineers, Inc. (Hydraulic Engineer)
Dave Daniels - Hanson Engineers, Inc. - (Geotechnical Engineer)

B. Dam:

The upstream face of the dam above the normal pool level is sloughing along its entire length. This is apparently due to wave erosion in combination with the relatively steep upstream slopes (see Photo No. 3). In many areas, this sloughing has proceeded to within 1 ft to 2 ft of the crest of the dam. Animal holes are also evident along the upstream face at the water level. There is no erosion protection on the front face of the dam.

The crest of the dam appeared to be in good condition. No obvious cracks or unusual movements were noted. Shallow auger probes into the dam indicated the embankment to consist of silty clay to clayey silt (modified loess).

The downstream face was fairly free of heavy vegetation, except for a few localized areas as indicated on sheet 4 of Appendix A. Animal holes were also noted, two of which were fairly large (Station 2+50 and 2+75 - holes 2 ft diameter and 3 ft deep). One 15 ft area at approximate station 1+50 had a considerable number of small animal holes and was disturbed to the extent that it appeared as if it could have been a slight slough. The area was not wet at the time of inspection.

No obvious seepage was noted except for two areas (see sheet 4 of Appendix A) which were damp and growing moss. The downstream face of the dam was fairly free of erosion.

A small erosion gully (a few inches deep) was noted at the downstream dam-abutment contact starting at the north abutment and proceeding toward the low point in the valley.

No instrumentation (monuments, piezometers, etc.) was observed.

C. Appurtenant Structures:

C.1 Primary Spillway:

The spillway is cut into bedrock in the south abutment (see Photos 9-14). The approach area is fairly clear except for a few small trees. There is no concrete control section. There is no bank erosion protection in the approach area or along the spillway. The spillway banks are fairly severely eroded (almost vertical in some areas especially along the south bank). The spillway has some wood debris, and a tree is about to fall in the channel, as shown in Photos 11 and 12.

C.2. Emergency Spillway:

There is no emergency spillway associated with this dam.

D. Reservoir:

The slopes adjacent to the lake are moderate, and no serious sloughing was noted. The watershed is wooded, and a residential area is along the north side of the lake. The water was somewhat turbid on the day of inspection. Some problems with siltation have been experienced (see Section 2.4).

E. Downstream Channel:

The outlet channel has some overgrowth of trees, but the channel is well away from the dam.

3.2 EVALUATION:

The erosion and sloughing of the upstream slope should be corrected and then maintained. Re-shaping (flatter slopes would be advisable) and erosion protection (riprap)

will be necessary. Animal holes should be repaired on both faces of the dam. Trees and brush should be removed on an annual basis. Erosional channels at the dam-abutment contacts should be repaired. Areas noted as possible seepage areas (see sheet 4 of Appendix A) should be investigated by an engineer experienced in the design and construction of dams. The spillway should be cleared of wood debris and overhanging vegetation. The spillway slopes may have to be stabilized in the future to prevent bank failures.

Photographs of the dam, appurtenant structures, and the reservoir are presented in Appendix D.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES:

There are no controlled outlet works for this dam. The spillway is uncontrolled, so that the pool is normally controlled by rainfall, runoff and evaporation.

4.2 MAINTENANCE OF DAM:

The owner indicated that brush and trees on the dam are cut every year.

4.3 MAINTENANCE OF OPERATING FACILITIES:

There are no operating facilities for this dam.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT:

The inspection team is unaware of any existing warning system for this dam.

4.5 EVALUATION:

Trees and brush should continue to be cut annually. Trees and brush in the south abutment area on the downstream face should also be cut and maintained. Animal holes should be filled, and erosional areas at dam-abutment contacts should be maintained. The spillway should be cleared of wood debris and overhanging vegetation periodically. The dam should be inspected periodically to detect possible seepage under or through the embankment.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES:

A. & B. Design and Experience Data:

The hydraulic and hydrologic analyses were based on: (1) a field survey of spillway dimensions and embankment elevations; and (2) an estimate of the pool and drainage areas from the U.S.G.S. quad sheet. No previous hydraulic or hydrologic studies were obtained. Our hydrologic and hydraulic analyses using U. S. Army Corps of Engineers guidelines appear in Appendix C.

C. Visual Observations:

The spillway is cut into bedrock in the south abutment (see Photos 9-14). The approach area is fairly clear except for a few small trees. There is no concrete control section. There is no bank erosion protection in the approach area or along the spillway. The spillway banks are fairly severely eroded (almost vertical in some areas--especially along the south bank). The spillway has some wood debris, and a tree is about to fall in the channel, as shown in Photos 11 and 12. The outlet area has some overgrowth of trees, but the channel is well away from the dam. The builder of the dam indicated the highest water ever experienced was approximately 4 ft above normal pool (approximate elevation 101.8). According to the builder and present owners, the dam has never been overtopped.

D. Overtopping Potential:

Based on the hydrologic and hydraulic analysis presented in Appendix C, the spillway will pass 33 percent of the Probable Maximum Flood. The Probable Maximum Flood is defined as the flood discharge that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region. The recommended guidelines from the Department of the Army, Office of the Chief of Engineers, require that this structure (small size with high downstream hazard potential) pass 50 percent to 100 percent of the PMF, without overtopping.

Considering the small size of the dam and its low storage capacity, 50 percent of the PMF has been determined to be the appropriate spillway design flood. The structure will pass a 100-year frequency flood without overtopping.

The routing of 50 percent of the PMF through the spillways and dam indicates that the dam will be overtopped by .88 ft at elevation 104.18. The duration of the overtopping will be .67 hours, and the maximum outflow will be 1932 cfs. The maximum discharge capacity of the spillway is 786 cfs. It should be noted that an average top-of-dam elevation of 103.3 was used for the hydraulic analysis.

Overtopping of an earthen embankment could cause serious erosion and could possibly lead to failure of the structure. The soils comprising this dam are quite silty (modified loess) and would be fairly erodible.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY:

A. Visual Observations:

Visual observations which could adversely affect the structural stability of this dam are discussed in Sections 3.1B and 3.2.

B. Design and Construction Data:

No design and construction data for the foundation and embankment were available. Information from the owner indicates that the dam is composed of materials taken from the basin area and slopes upstream of the dam. Our site inspection indicates that these materials are primarily low plasticity silty clays and clayey silts (modified loess). The owner indicated that a 10 ft deep core trench was incorporated under the dam. No internal drainage features were incorporated, nor is there any particular zoning of the embankment. No construction inspection records are available. Seepage and stability analyses comparable to the requirements of the guidelines were not available, which constitutes a deficiency which should be rectified.

C. Operating Records:

No operating records have been obtained.

D. Post-Construction Changes:

The inspection team is not aware of any post-construction changes to the dam.

E. Seismic Stability:

The structure is located in seismic zone 2 near the boundary of zones 1 and 2. An earthquake of this magnitude would not generally be expected to cause severe structural damage to a well constructed earth dam of this size. However, due to the rather steep slopes of the embankment, it is recommended that the prescribed seismic loading for this zone be applied in stability analyses performed for this dam.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT:

This Phase I inspection and evaluation should not be considered as being comprehensive since the scope of work contracted for is far less detailed than would be required for an in-depth evaluation of dams. Latent deficiencies, which might be detected by a totally comprehensive investigation, could exist.

A. Safety:

The embankment is generally in good condition, although the slopes (especially the upstream slopes) are relatively steep. The sloughing, which has occurred on the upstream face above the waterline, is probably due, to some extent, to the steepness of the embankment slopes. Several items were noted during the visual inspection which should be investigated further, corrected or controlled. These items are: (1) sloughing of upstream slope all along the dam; (2) animal burrows on both faces of the dam; (3) light brush on the upstream face and several isolated areas of heavy brush on the downstream face; (4) two damp, mossy areas on the downstream face which could indicate some slight seepage; (5) one area on the downstream face which appears to be a small slough but was not active at the time of the inspection; and (6) debris and erosion in the spillway channel.

The dam will be overtopped by flows in excess of 33 percent of the Probable Maximum Flood. Overtopping of an earthen embankment could cause serious erosion and could possibly lead to failure of the structure. The soils comprising this dam are quite silty (modified loess) and would be fairly erodible.

B. Adequacy of Information:

The conclusions in this report were based on the construction and performance history as related by others, and visual observation of external conditions. The inspection team considers that these data are sufficient to support the conclusions herein. Seepage and stability analyses comparable to the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency.

C. Urgency:

The remedial measures recommended in paragraph 7.2 should be accomplished in the near future. If the deficiencies listed in paragraph A are not corrected, and if good maintenance is not provided, the embankment condition will deteriorate and possibly could become serious in the future. Priority should be given to increasing the size of the spillway.

D. Necessity for Phase II:

Based on the result of the Phase I inspection, no Phase II inspection is recommended.

E. Seismic Stability:

The structure is located in seismic zone 2 near the boundary of zones 1 and 2. An earthquake of this magnitude would not generally be expected to cause severe structural damage to a well constructed earth dam of this size. However, it is recommended that the prescribed seismic loading for this zone be applied in any stability analyses performed for this dam.

7.2 REMEDIAL MEASURES:

The following remedial measures and maintenance procedures are recommended. All remedial measures should be performed under the guidance of a professional engineer experienced in the design and construction of dams.

(1) Spillway size and/or height of dam should be increased to pass 50 percent of the PMF. It should be noted that the overtopping depth as indicated in Section 5.1d does not represent the required increase in height of the dam.

(2) Seepage and stability analyses comparable to the requirements of the recommended guidelines should be performed by an engineer experienced in the construction of dams.

(3) The erosion and sloughing of the upstream slope should be corrected and maintained. Re-shaping (flatter slopes would be advisable) and placement of erosion protection (riprap) will be necessary.

(4) Animal holes should be repaired on both faces of the dam.

(5) Trees and brush, as indicated in those areas as shown on sheet 4 of Appendix A, should be removed. This should be done under the guidance of a professional engineer experienced in the design and construction of dams. Indiscriminate clearing methods could jeopardize the safety of the dam.

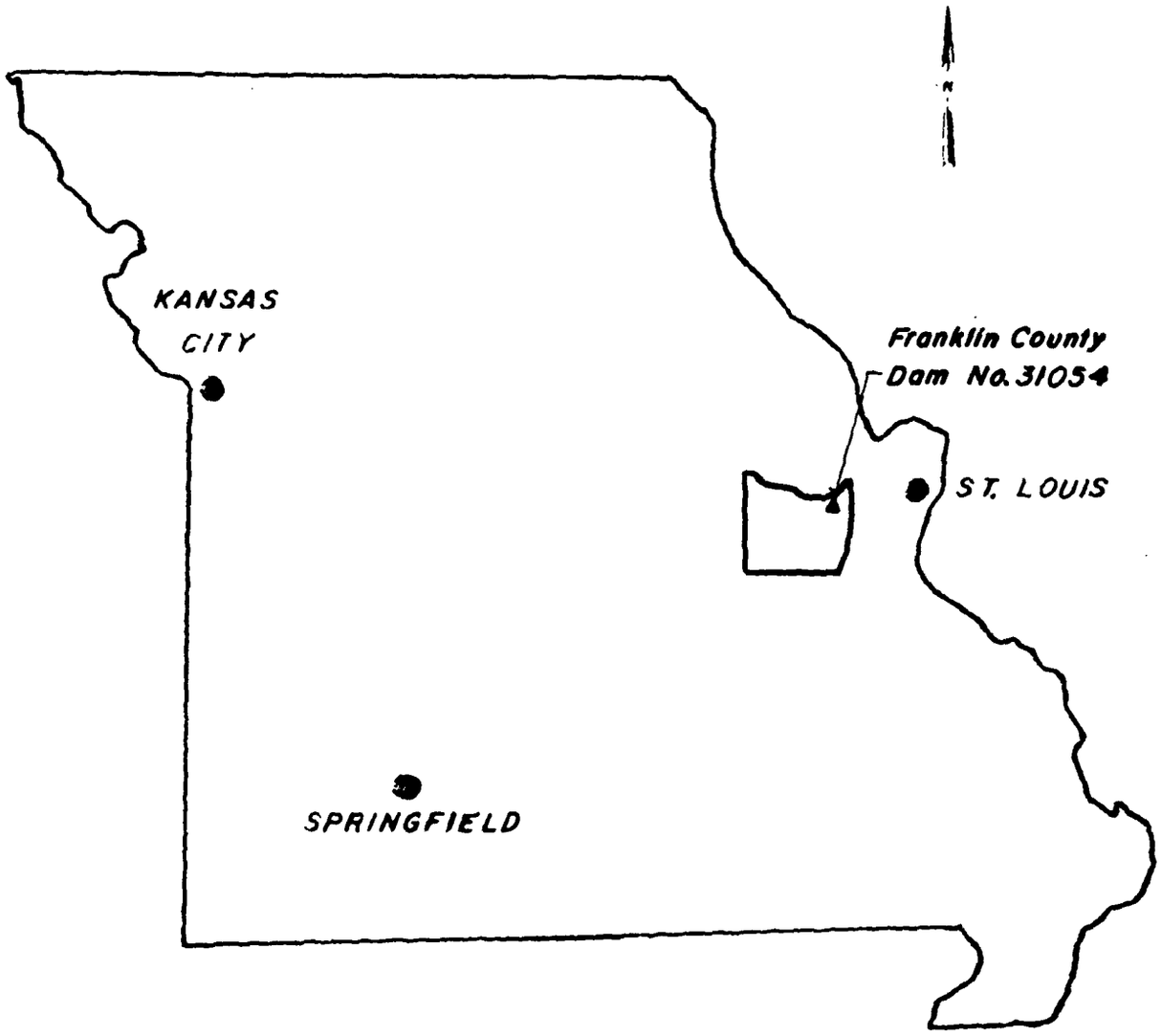
(6) Erosional areas at dam-abutment contacts should be corrected and maintained.

(7) The possible seepage areas, as indicated on sheet 4 of Appendix A, should be evaluated by an engineer experienced in the design of dams.

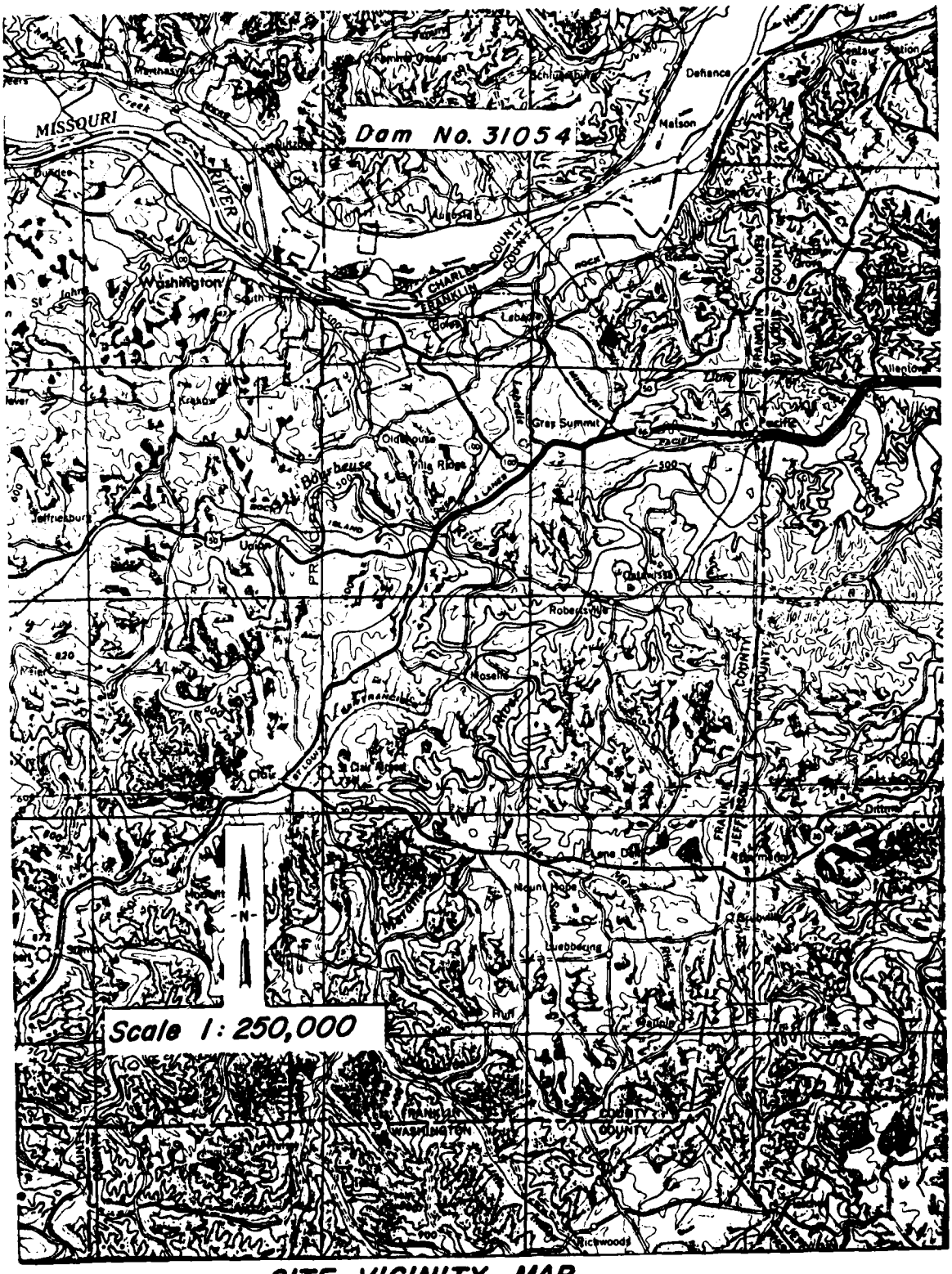
(8) The spillway should be cleared of wood debris and overhanging vegetation. The spillway slopes may have to be stabilized in the future to prevent bank failures. It would also appear advisable to provide some erosion protection in the spillway approach area on the embankment side.

(9) A detailed inspection of the dam should be made periodically by an engineer experienced in the design and construction of dams.

APPENDIX A

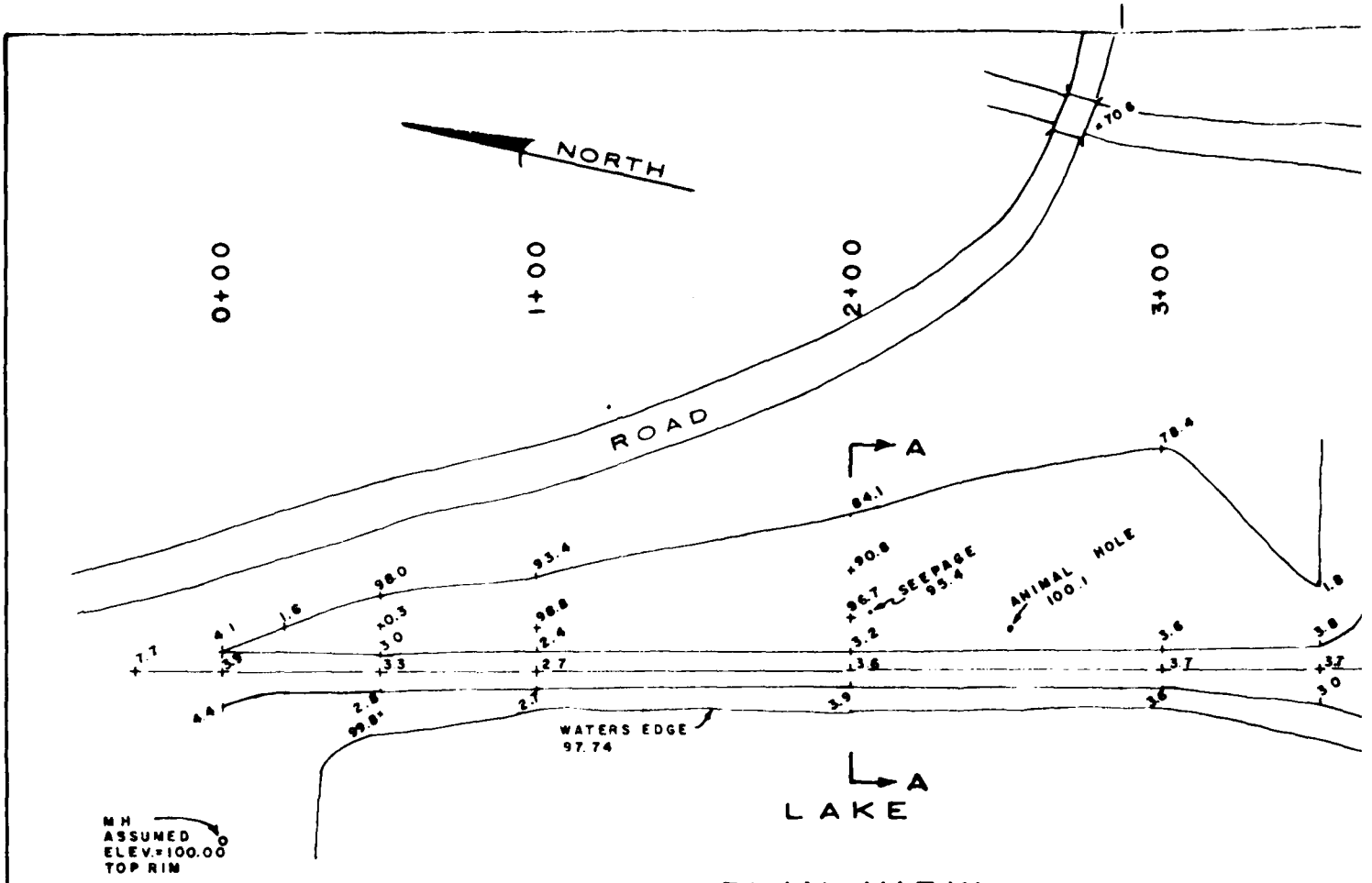


LOCATION MAP

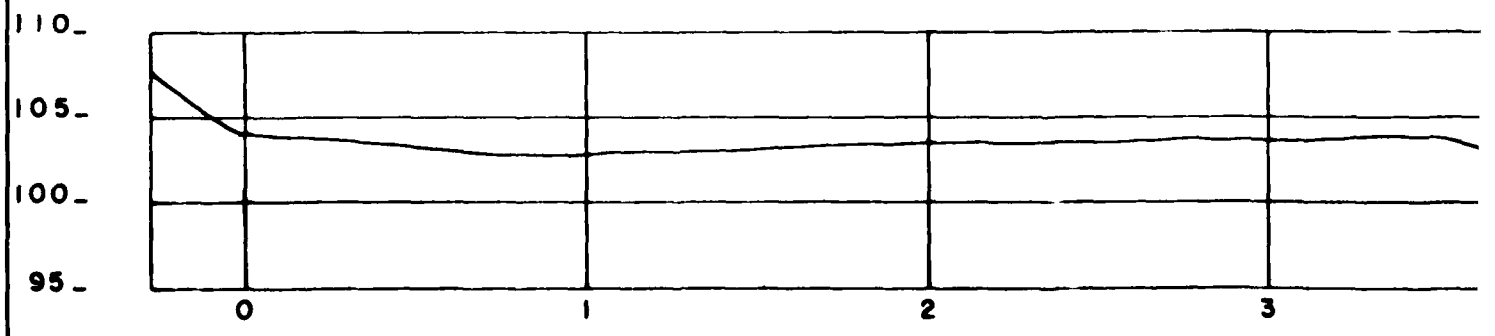


SITE VICINITY MAP

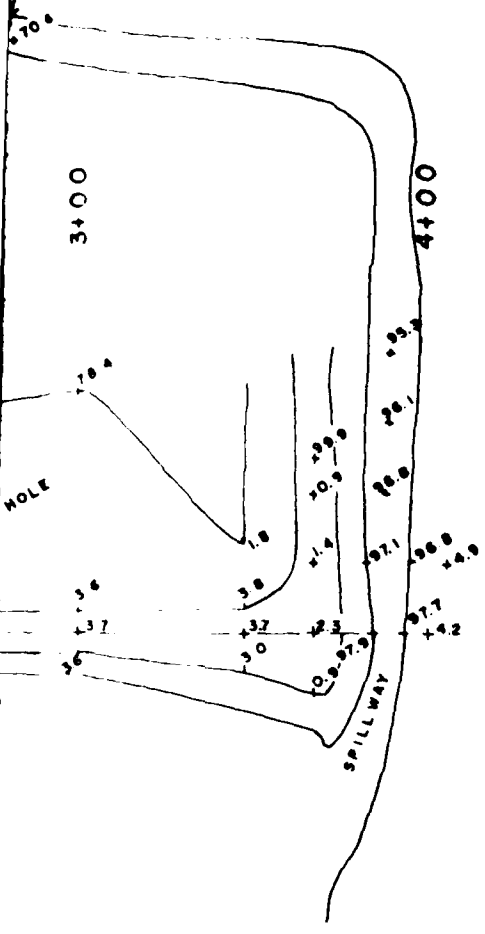
Sheet 2 Appendix A



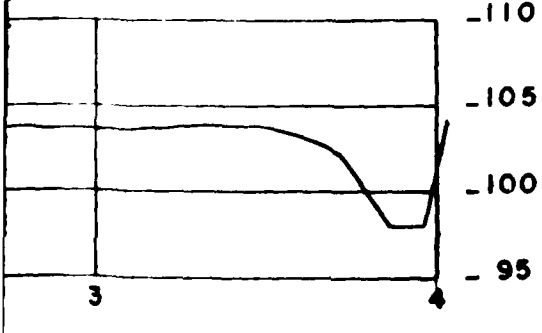
PLAN VIEW
SCALE: 1" = 50'



PROFILE



SECTION A-A STA 2+00



ANDERSON ENGINEERING, INC.
730 NORTH BENTON AVENUE
SPRINGFIELD, MISSOURI 65802

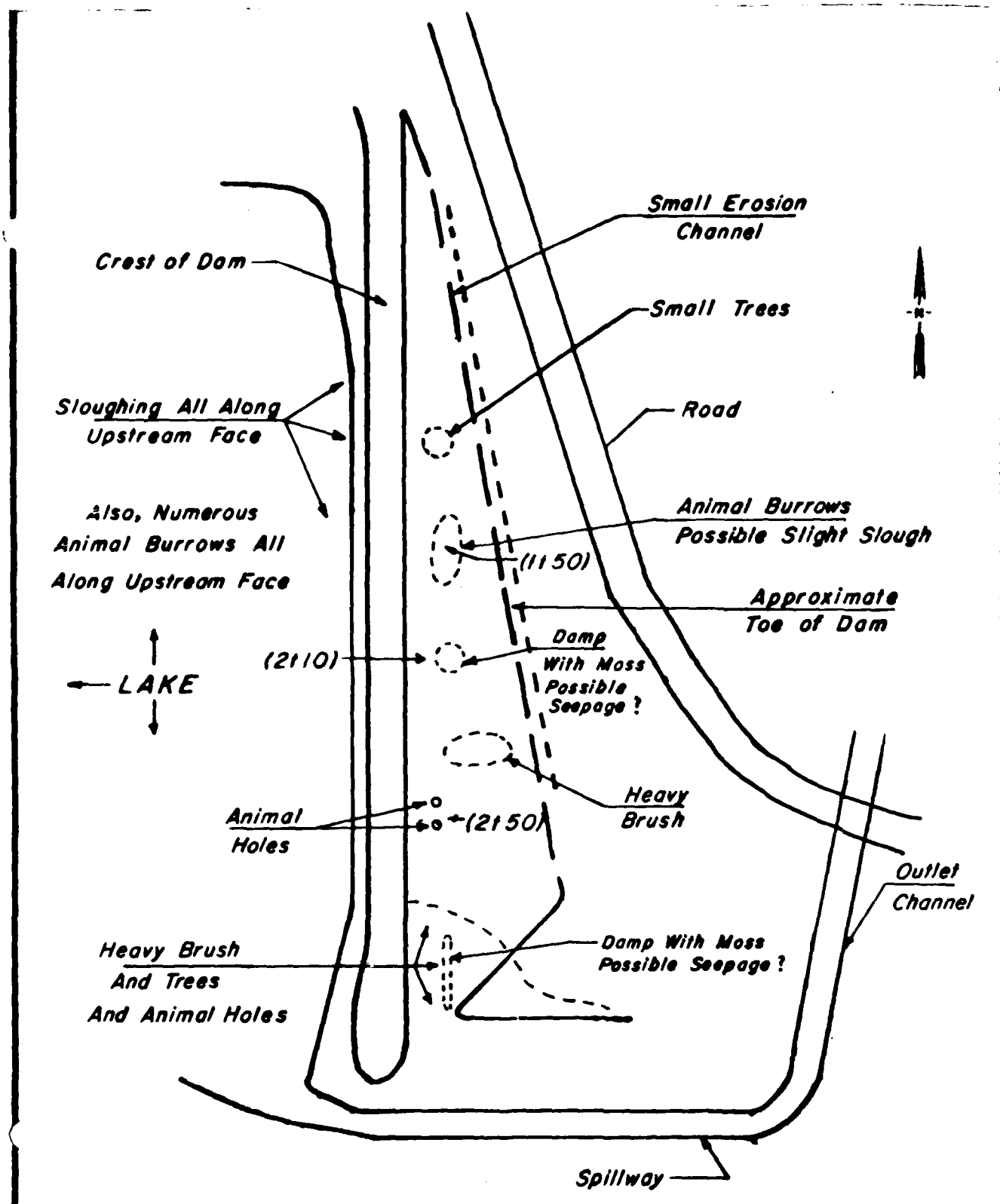
HERMIT HOLLOW LAKE
MO. No. 31054

PLAN & PROFILE

Sheet 3 Appendix A

FRANKLIN COUNTY, MO.

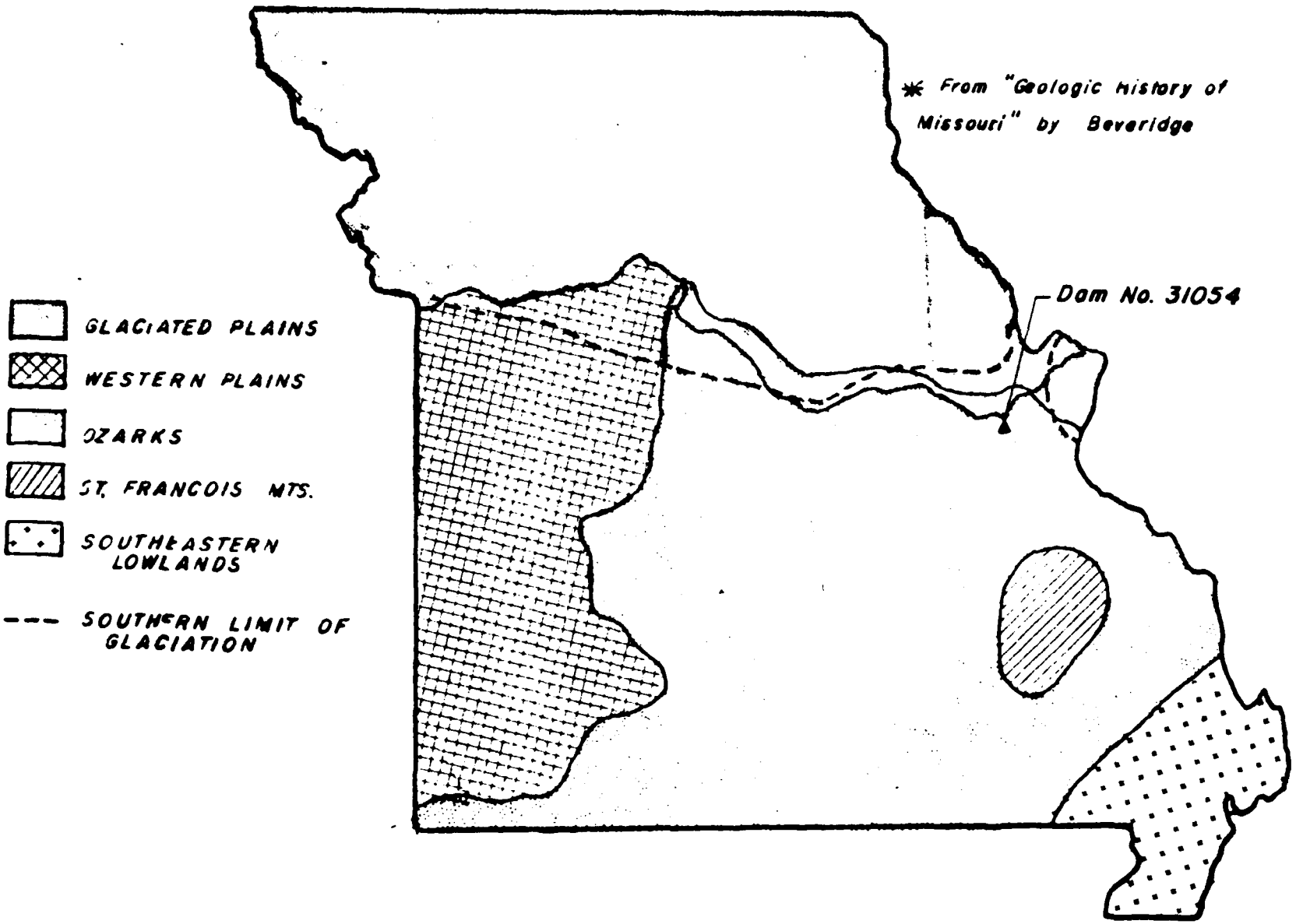
2



DRAWN DER CHECKED DED DATE 6-6-79 JOB NO. 79511	HANSON ENGINEERS SPRINGFIELD ILL. PEORIA ILL	Plan Sketch Inspection Observations Sheet 1 Appendix A

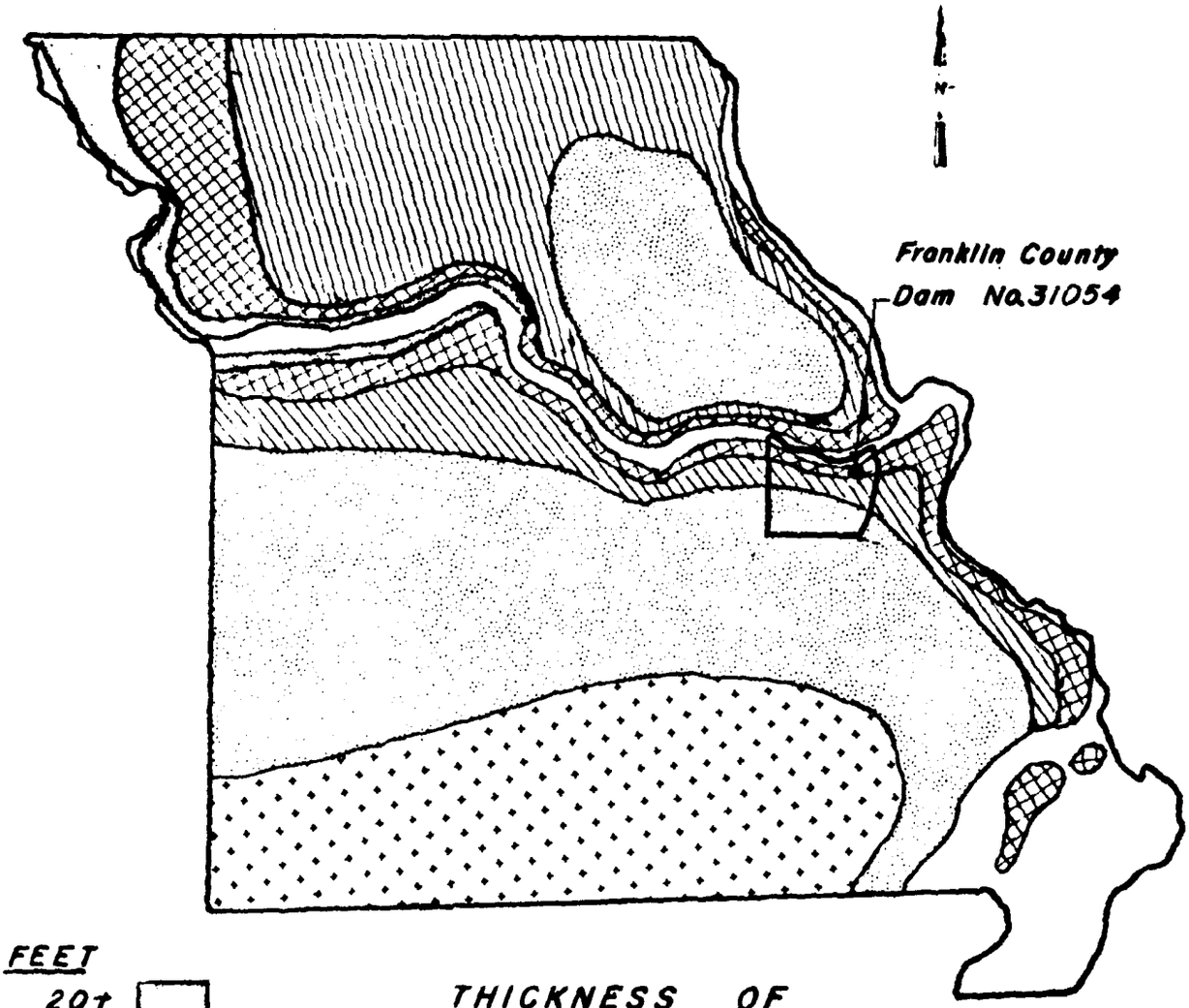
APPENDIX B

MAJOR GEOLOGIC REGIONS OF MISSOURI



SHEET 1 OF APPENDIX B

* From "Soils of Missouri"



FEET

20+

10-20

5-10

2.5-5

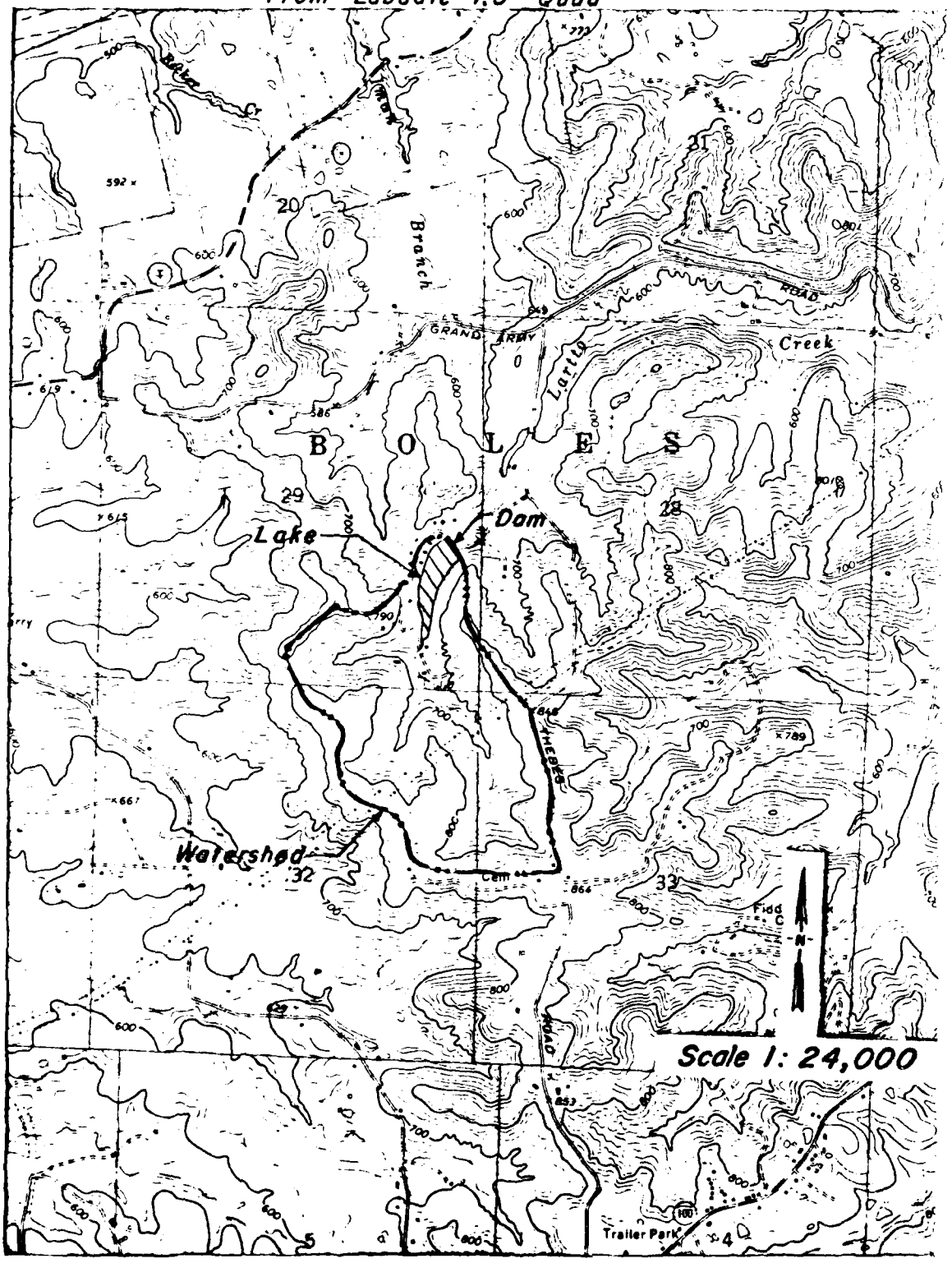
2.5-

THICKNESS OF
LOESSIAL DEPOSITS

SHEET 2 OF APPENDIX B

APPENDIX C

From Labadie 7.5' Quad



LAKE AND WATERSHED MAP

Sheet 1 Appendix C

HYDRAULIC AND HYDROLOGIC DATA

Design Data: From Field Measurements and Computations

Experience Data: No records are available.

Visual Inspection: At the time of the inspection the pool level was approximately at normal pool.

Overtopping Potential: Flood routings were performed to determine the overtopping potential. The watershed and the reservoir surface areas were obtained by planimeter from the U.S.G.S. Labadie, Missouri 7.5 minute quadrangle map. The storage volume was developed from this data. A 5 minute interval unit graph was developed for this watershed, which resulted in a peak inflow of 891 c.f.s. and a time to peak of 10 minutes. Application of the probable maximum precipitation minus losses results in a flood hydrograph peak inflow of 4722 c.f.s. Rainfall distribution for the 24 hour storm was according to EM 1110-2-1411.

Based on our analyses, the spillway will pass 33 percent of the Probable Maximum Flood (PMF). The Probable Maximum Flood is defined as the flood discharge that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region. The recommended guidelines from the Department of the Army, Office of the Chief of Engineers, require that the structure (small size with high downstream hazard potential) pass 50 to 100 percent of the PMF, without overtopping. Considering its small size and low storage capacity, 50 percent of the PMF has been determined to be the appropriate spillway design flood.

The routing of 50 percent of the PMF through the spillway and dam indicates that the dam will be overtopped by 0.88 ft at elevation 104.18. The duration of the overtopping will be 0.67 hours, and the maximum outflow will be 1932 c.f.s. The maximum discharge capacity of the spillway is 786 c.f.s. Analysis of the data indicates that the 100-year frequency flood will not overtop the dam.

OVERTOPPING ANALYSIS FOR HERMIT HOLLOW LAKE DAM

INPUT PARAMETERS

1. Unit Hydrograph - SCS Dimensionless - Flood Hydrograph Package (HEC-1); Dam Safety Version Was Used.
   Hydraulic Inputs Are As Follows:

   a. Twenty-four Hour Rainfall of 25.3 Inches For 200 Square Miles - All Season Envelope

   b. Drainage Area = 249 Acres; = 0.39 Sq. Miles

   c. Travel Time of Runoff 0.26 Hrs.; Lag Time 0.16 Hrs.

   d. Soil Conservation Service Soil Group B

   e. Soil Conservation Service Runoff Curve No. 85 (AMC III)

   f. Proportion of Drainage Basin Impervious 0.02

2. Spillways

   a. Primary Spillway: Trapezoidal Channel; Side Slopes Vary; Rock bottom Length 9 ft; C = 2.65

   b. Emergency Spillway None

      Length - Ft.; Side Slopes -; C = -

   c. Dam Overflow

      Length 365 Ft.; Crest El. 103.3; C = 3.0

3. Spillway and Dam Rating:

   Curve Prepared by Hanson Engineers. Data Provided To Computer on Y4 and Y5 Cards.

Note: Time of Concentration From Equation $Tc = \left(\frac{11.9\ L^3}{H}\right)^{.385}$

California Culvert Practice, California Highways and Public Works, Sept. 1942.

SUMMARY OF DAM SAFETY ANALYSIS

1. Unit Hydrograph

   a. Peak - 891 c.f.s.

   b. Time to Peak 10 Min.

2. Flood Routings Were Computed by the Modified Puls Method

   a. Peak Inflow

      50% PMF 2361 c.f.s.; 100% PMF 4722 c.f.s.

   b. Peak Elevation

      50% PMF 104.18 100% PMF 105.30

   c. Portion of PMF That Will Reach Top of Dam

      33 %; Top of Dam Elev. 103.3 Ft.

3. Computer Input and Output Data are shown on Sheets 5 and 6 of this Appendix.

```
A       OVERTOPPING ANALYSIS FOR HERMIT HOLLOW LAKE DAM #22
A       CO CODE 071 FRANKLIN CO MO 31054 OWNER HERMIT HOLLOW TRUSTEES
A       HANSON ENGINEERS INC. DAM SAFETY INSPECTION JOB #79511
B   300                 5
B1    5
J     1       6       1
J1  0.2     0.3     0.4     0.5     0.6     1.0
K     0       1                               3       1
K1      INFLOW HYDROGRAPH COMPUTATION
M     1       2    0.39            0.39       1                       1
P     0    25.3     102     120     130
T                                                       -1      -85             0.02
U2 0.26    0.16
X     0    -0.1       2
K     1       2                       2       4       1
K1      RESERVOIR ROUTING BY MODIFIED PULS AT HERMIT HOLLOW LAKE
Y                               1       1
Y1    1                                                 82      -1
Y4 97.8    98.8    99.8   100.8   101.8   102.3   103.7   104.0   105.0   106.0
Y5    0      29     101     220     403     506     873     982    1254    1556
$A    0       9      12
$E 70.7    97.7   103.7
$$ 97.8
$D 103.3     3.0     1.5     365
K    99
```

********** ********** ********** ********** **********

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5	RATIO 6
				0.20	0.30	0.40	0.50	0.60	1.00
HYDROGRAPH AT	1	0.39	1	944.	1417.	1889.	2361.	2833.	4722.
	(	1.01)	(	26.74)(	40.11)(	53.49)(	66.86)(	80.23)(	133.71)(
ROUTED TO	2	0.39	1	426.	708.	1265.	1932.	2429.	4444.
	(	1.01)	(	12.07)(	20.04)(	35.83)(	54.72)(	68.78)(	125.85)(

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

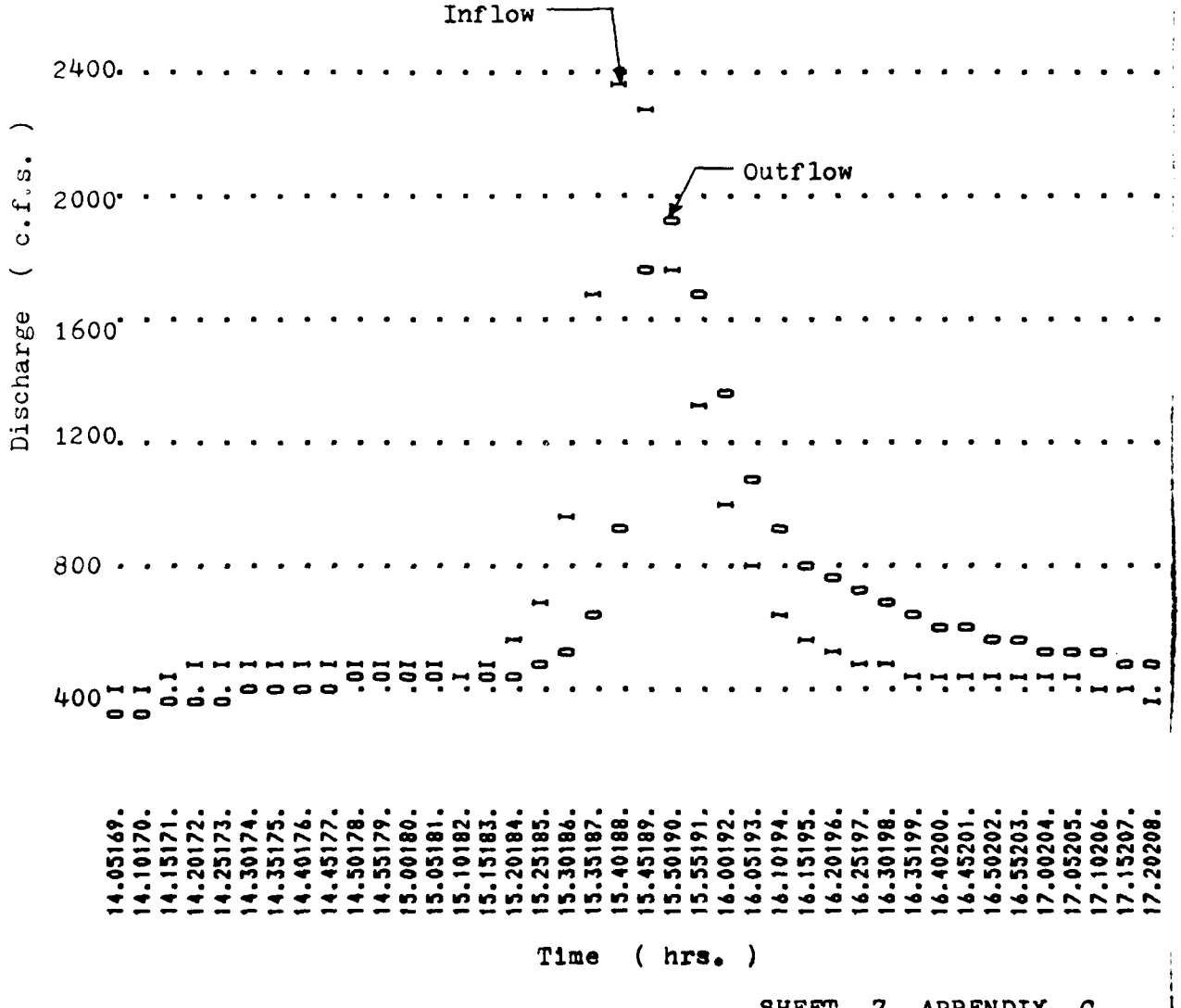
	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	97.80	97.80	103.30
STORAGE	82.	82.	139.
OUTFLOW	0.	0.	768.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
0.20	101.91	0.00	123.	426.	0.00	16.00	0.00
0.30	103.07	0.00	136.	708.	0.00	15.92	0.00
0.40	103.78	0.48	145.	1265.	0.50	15.83	0.00
0.50	104.18	0.88	150.	1932.	0.67	15.83	0.00
0.60	104.44	1.14	153.	2429.	0.83	15.83	0.00
1.00	105.30	2.00	164.	4444.	3.25	15.75	0.00

INFLOW - OUTFLOW
HYDROGRAPH
FOR 50% P. M. F.

Max. Inflow = 2,361 c.f.s.

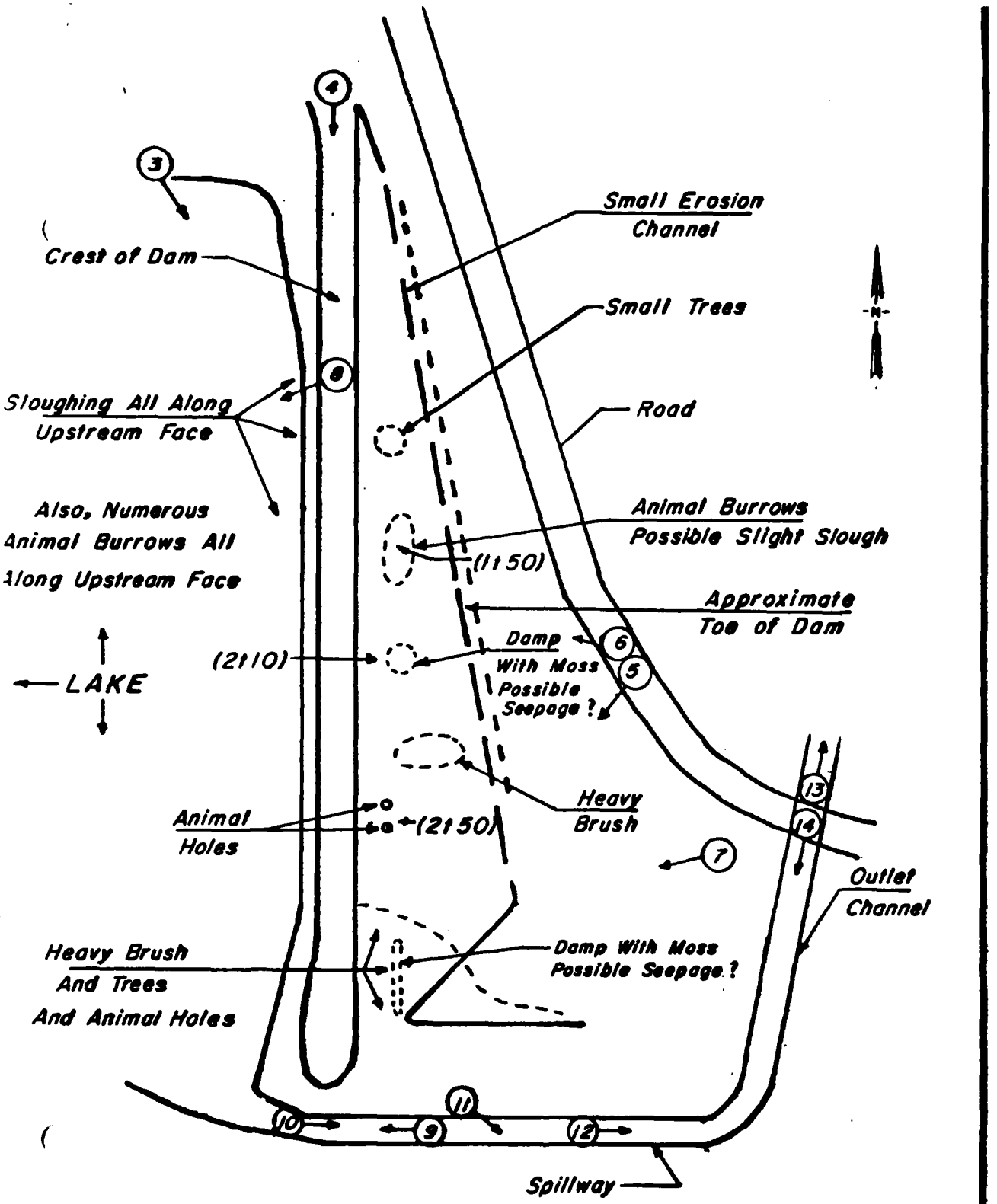
Max. Outflow = 1,932 c.f.s.



APPENDIX D

LIST OF PHOTOGRAPHS

Photo No.	Description
1.	Aerial - Looking East at Lake and Watershed
2.	Aerial - Look West at Dam
3.	Upstream Face - Note Sloughing
4.	Crest of Dam - Looking South
5.	Downstream Face - Note Heavy Brush, Sta. 2+30
6.	Downstream Face - Looking Toward North Abutment
7.	South Abutment Area - Note Trees and Brush
8.	Lake - Looking From Crest of Dam
9.	Spillway Approach - Looking Upstream
10.	Spillway - Looking Downstream
11.	Spillway- Looking Downstream, Note Eroded Slopes and Tree about to fall in.
12.	Spillway - Looking Downstream - Note Debris
13.	Outlet Channel - Looking Downstream
14.	Outlet Channel - Looking Upstream



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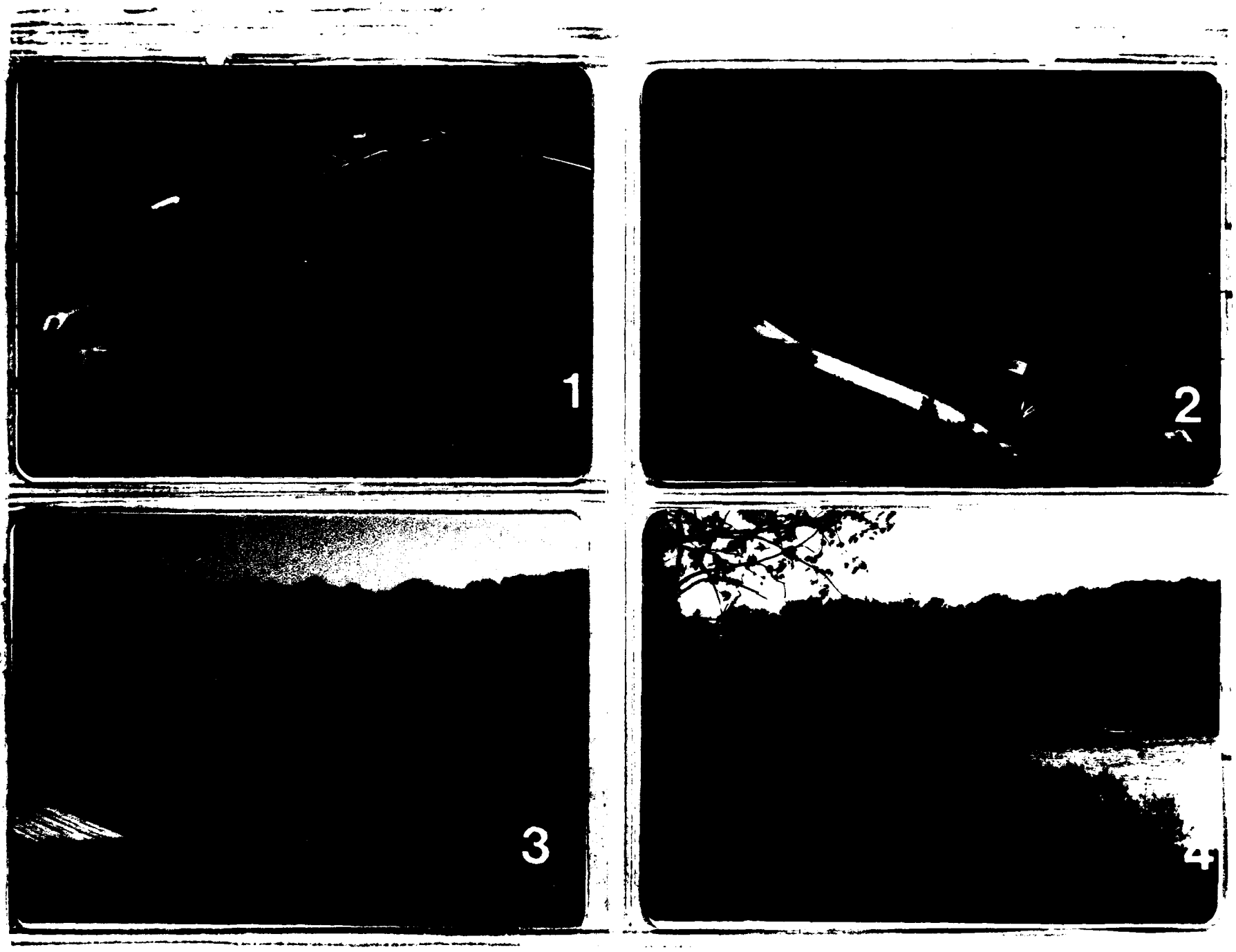
HANSON ENGINEERS
SPRINGFIELD ILL. PEORIA ILL.

Plan Sketch
Key To Photographs
Sheet 2 Appendix D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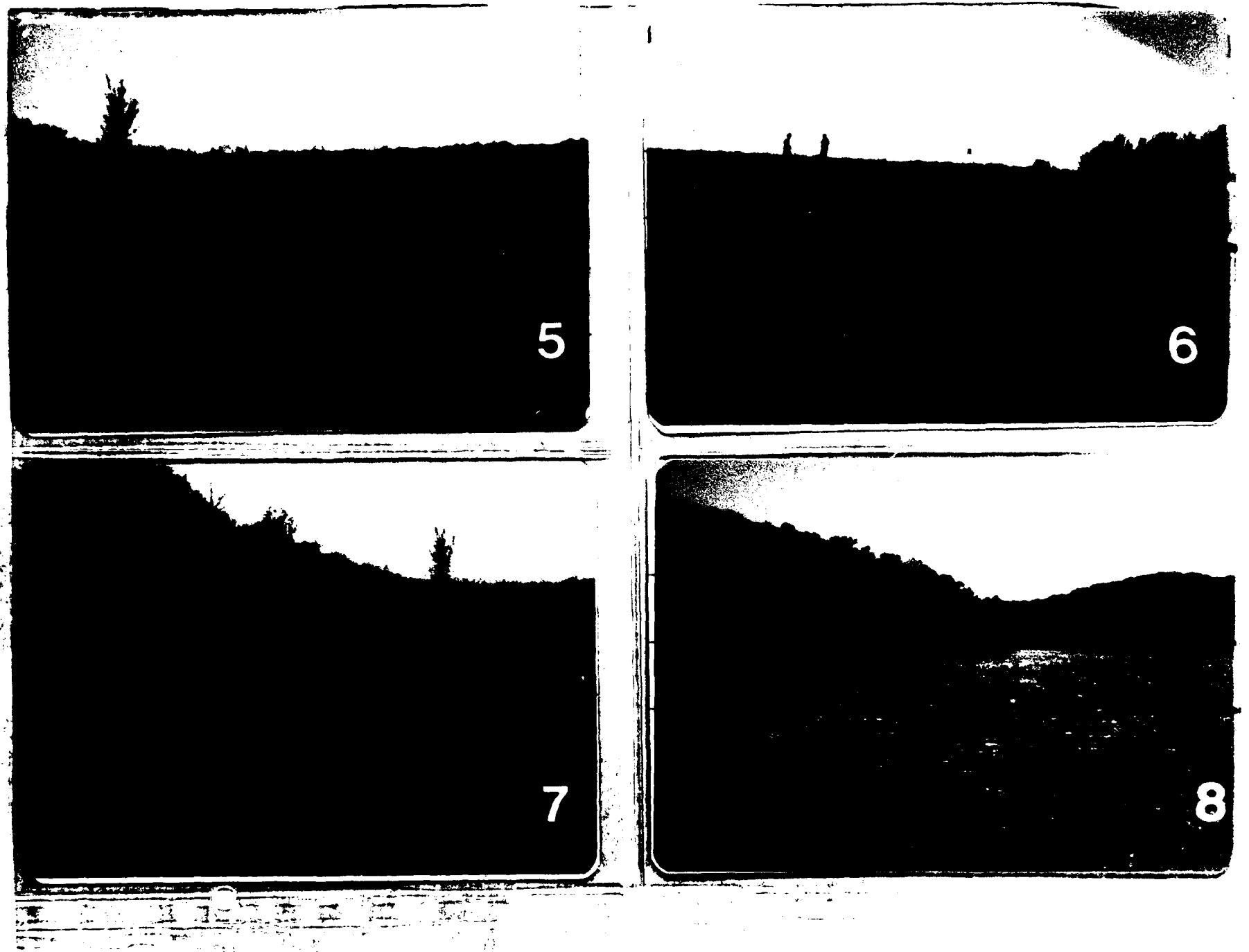
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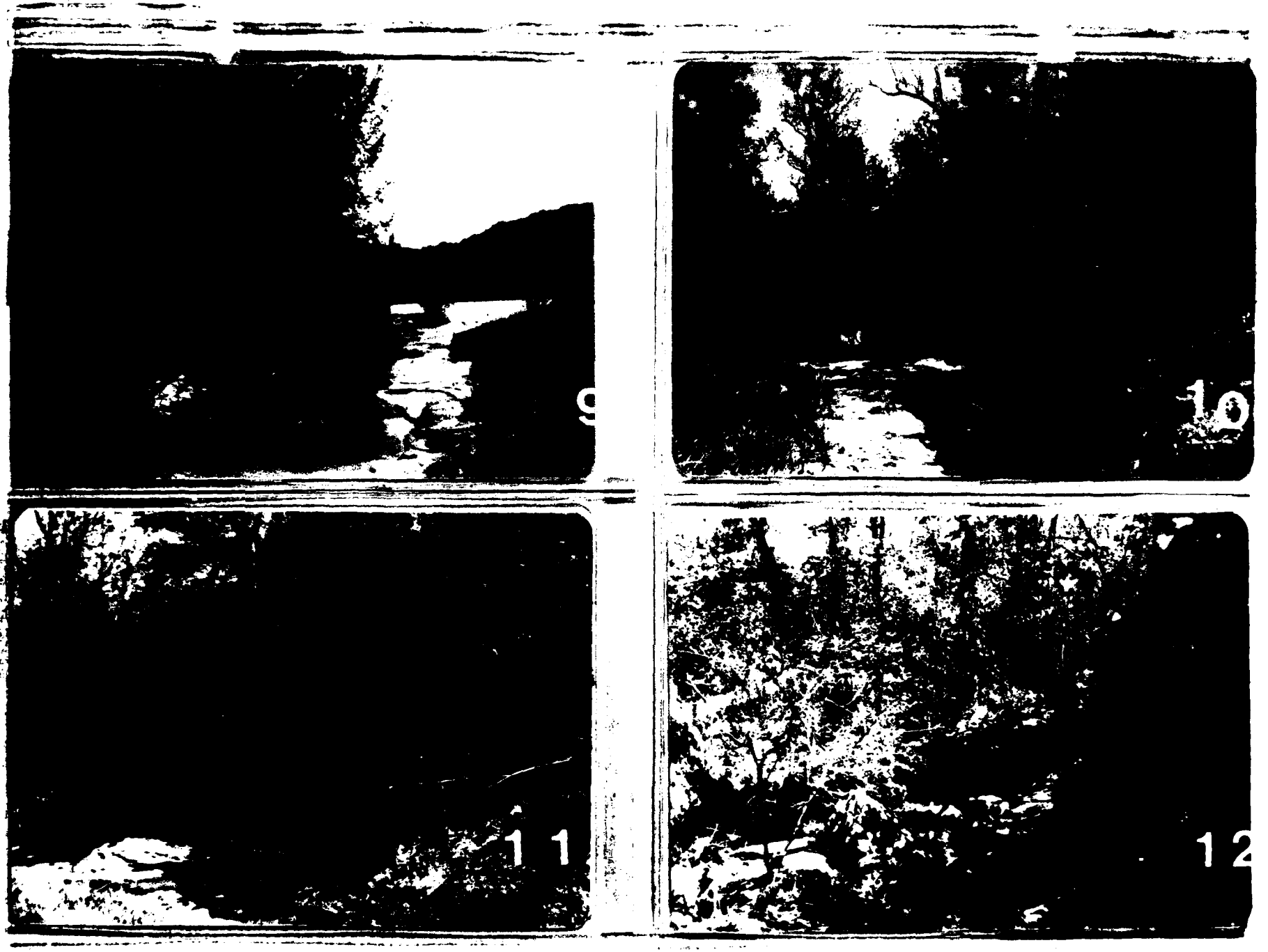
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11
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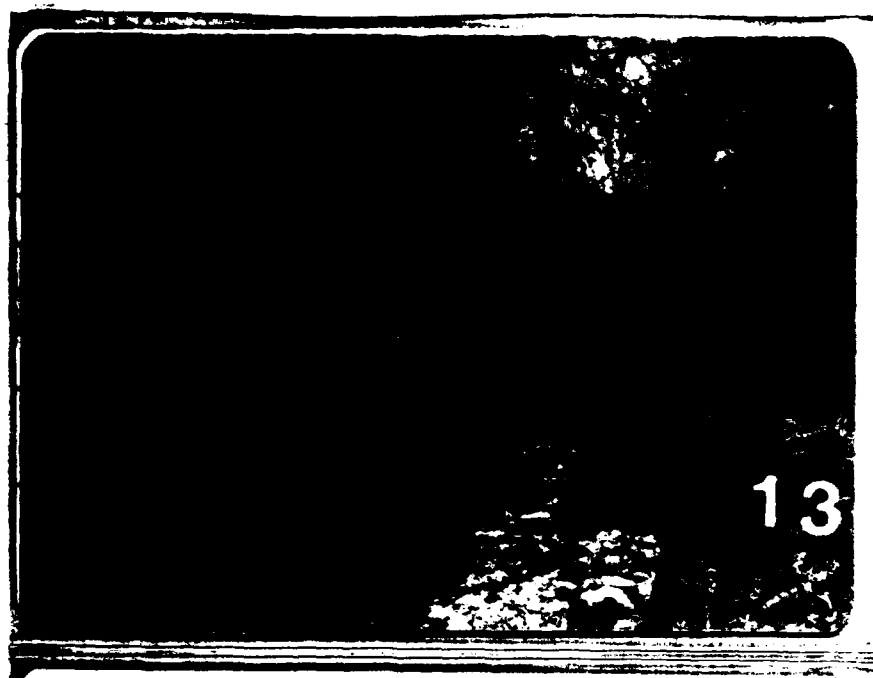

SUBJECT

LOCATION

SUBJECT

LOCATION

OF

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